Application/Control Number 10/764,139
Art Unit: 3746

Amendments to Claims:

Claims 1-21 (canceled)

Claim 22 (new)

A double-acting, reciprocating piston, high-pressure, cryogenic pump comprising:

a cylinder;

a piston rod;

a pair of spaced apart piston heads on said piston rod defining left side and right side pump chambers each having a suction valve communicating with a source of cryogenic suction liquid;

each of said piston heads having a set of high-pressure seals;

venting passageways for venting blow-by vapors or fluids between said piston seals;

said venting passageways including a first generally radial venting passageway between said piston heads connected to a second axial venting passageway in said piston rod;

said second axial passageway being in communication with said source of cryogenic suction liquid;

said blow-by vapors or fluids mix and condense in said suction liquid;

whereby said blow-by vapors or fluids are condensed in said suction liquid and do not interfere with normal operation of said cryogenic pump.

Claim 23 (new)

A double-acting, reciprocating piston, high pressure, cryogenic pump comprising:

a cylinder;

a piston rod;

a pair of spaced apart piston heads on said piston rod defining left side and right side pump chambers with said cylinder;

said pump chambers each having a suction valve communicating with a source of cryogenic suction liquid;

each of said piston heads having a set of high-pressure seals;

said cylinder having at least one vent hole passageway in a plane approximately mid-stroke of said piston head seals;

said vent hole passageway in said cylinder in communication with said source of suction liquid;

any blow-by vapors leaking past said high-pressure sets of seals mix and condense in said suction liquid;

whereby blow-by vapors are condensed in said suction liquid and do not interfere with normal operation of said cryogenic pump.

Claim 24 (new)

A method for pumping a cryogenic liquid with a double-acting, reciprocating piston pump from suction pressure to high-pressure comprising the steps of:

providing a cylinder with cylinder heads at opposite ends each having suction and discharge valves;

providing a piston rod with seals extending through one of said cylinder heads;

providing a pair of spaced apart piston heads on said piston rod;

providing a set of high-pressure seals on each of said piston heads which are slidable in the bore of said cylinder;

providing a low-pressure cavity between said spaced apart sets of high-pressure seals and communicating said low pressure cavity to a source of cryogenic suction liquid via a passageway;

said spaced apart piston heads defining left side an right side pump chambers in said cylinder;

providing an insulating jacket filled with said suction liquid surrounding said cylinder and said cylinder heads;

flowing said suction liquid into said right side pump chamber with increasing volume due to the direction of motion of said piston head and simultaneously discharging high-pressure liquid from said left side pump chamber;

flowing said suction liquid into said left side pump chamber during the return stroke of said piston rod and simultaneously discharging high-pressure liquid from said right side pump chamber and venting any blow-by vapors present in said low-pressure cavity to said source of cryogenic suction liquid through said passageway so that the blow-by vapors are mixed and condensed in said suction liquid.

Claim 25 (new)

A method for pumping a cryogenic liquid with a double-acting, reciprocating piston pump from suction pressure to high-pressure comprising the steps of:

providing a cylinder with cylinder heads at opposite ends each having suction and discharge valves;

providing a piston rod with seals extending through one of said cylinder heads;

providing a pair of spaced apart piston heads on said piston rod;

providing a set of high-pressure seals on each of said piston heads which are slidable in the bore of said cylinder;

providing at least one vent hole passageway in said cylinder in a plane approximately mid-stroke of said piston head seals;

providing a low-pressure cavity between said spaced apart sets of high-pressure seals and communicating said low-pressure cavity to a source of cryogenic suction liquid via said vent hole passageway;

said spaced apart piston heads defining left side and right side pump chambers in said cylinder;

providing an insulating jacket filled with said cryogenic suction liquid surrounding said cylinder and said cylinder heads;

flowing said cryogenic suction liquid into said right side pump chamber with increasing volume due to the direction of motion of said piston head and simultaneously discharging high-pressure liquid from said left side pump chamber;

flowing said cryogenic suction liquid into said left side pump chamber during the return stroke of said piston rod and simultaneously discharging high-pressure liquid from said right side pump chamber and venting any blow-by vapors present in said low-pressure cavity to said source of cryogenic suction liquid through said vent hole passageway so that the blow-by vapors are mixed and condensed in said cryogenic suction liquid.